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EXPERIMENTAL STUDY ON PLASTICIZING EFFECTS OF DISTILLERY SPENTWASH IN CONCRETE

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ABSTRACT

A strategy using distillery spent wash as admixture in concrete is presented in this paper. The properties of fresh and hardened concrete made with distillery spent wash are presented and discussed. Proportions of 0-1.25% of distillery spent wash were added in concrete specimen, for the purpose of experimentation concrete mixes were designed for M_{20} grade. The compressive and flexural tests were conducted to study the strength, slump cone and compaction factor tests were conducted to study the workability of concrete using distillery spent wash. The results indicated that the distillery spent wash in concrete is a viable and effective reuse option, in particular when used in proportions of 0.75% addition.

KEYWORDS: Distillery Spent Wash, Super Plasticizer, Workability, Compressive Strength, Flexural Strength

INTRODUCTION

Current population explosion globally urges enlargement of industrial sectors resulting in pollution of water, air and soil. The discharge of pollutants into the environment from various industries poses a threat to living organisms resulting in a greater environmental stress. One such industry of rapid development is the distillery industry. Distilleries, the alcohol producing industries, are one of the major polluting industries, as about 88% of its raw material ends up as waste. There are 295 distilleries in India, producing 2.7 billion liters of alcohol and generating 40 billion liters of spent wash annually. Spent wash is the dark brown colour, hydrophilic viscous liquid waste disposed from distillery industry. Disposal of these waste in rivers, lakes or lagoons which, in turn, decrease both photosynthetic activity and dissolved oxygen concentration causing harm to aquatic life. Disposal of spent wash on land is equally hazardous causing a reduction in soil pH and inhibition of seed germination. The colored compounds in spent wash have antioxidant properties and become toxic to microorganisms. The disposal of such waste becomes a big problem for distillery industries. In the present investigation, we made an attempt to use this distillery waste as water reducing admixture in concrete.

MATERIALS AND EXPERIMENTAL PROGRAMME

In this study, for concrete specimens tested, the distillery spent wash was used as a super plasticizer in concrete at dosages of 0%, 0.25%, 0.5%, 0.75%, 1% and 1.25% by weight of cement. The water-to-cement ratios (w/c) were 0.50, 0.48, and 0.46.

Distillery Spent Wash

Distillery spent wash was collected from Salem co-operative sugar mills Ltd, Mohanur, Tamilnadu. The physical and chemical properties of distillery spent wash were tested and it is found that pH value of spent wash is 4.83. The pH value of material less than 6 become acidic; so that proper treatment is required for distillery spent wash before using it as a super plasticizer in concrete. 30 g/l of lime is added in spent wash and the pH value of spent wash is tested. The pH value of lime added spent wash is 6.7. Generally distillery spent wash contain melanoidin, caramel and humin compounds which

may reduce the strength of concrete. Quality of spent wash can be improved by adding adsorbent to adsorb the melanoidin, caramel and humin compounds present in spent wash. Activated charcoal was added as a adsorbent, then the mixture was stirred and allowed to settle, the sediment was discarded and the solution was used as a super plasticizer. The physio-chemical properties of spent wash is shown in table.1.

Table 1: Physiochemical Properties of Treated Distillery Spent Wash

Characteristics	Value
Colour	Dark brown
Odour	Unpleasant burnt sugar
Specific gravity	1.2
pH	6.7
Organic Carbon (%)	3.7
Dry matter	18-26%
Hexoses	2%
Inverted sugar	0.2 – 1%
Pigments	4 – 8%
Ash	6 – 10%
Organic acids	6 – 10%
Ligin	50 – 55%

Concrete Specimens

In order to investigate the effect of distillery spent wash on the resulting concrete performance, distillery spent wash was added at various percentages by weight of cement and concrete cubes and prisms were casted using standard Portland Pozzalana cement. The mix ratio for control mix is 1: 1.56 : 3.02 with w/c of 0.5.

Compressive strength of concrete at ages of 7, 28 days were performed. Concrete specimens were cast in 150x150x150 mm cube molds and cured at room temperature. Similarly flexural strength of concrete at age of 28 day was performed. Concrete prisms were cast in molds with dimensions of 100x100x500 mm. The mix proportions of concrete are shown in table 2.

Table 2: Mix Proportions

Mix	w/c	Cement Content (Kg/m^3)	Fine Aggregate (Kg/m^3)	Coarse Aggregate (Kg/m^3)	Water (Kg/m^3)
M_1	0.50	383	597.50	1157	191.50
M_2	0.48	383	597.50	1157	183.84
M_3	0.46	383	597.50	1157	176.18

RESULTS AND DISCUSSIONS

Properties of Fresh Concrete

Slump & Compaction Factor

Figure 1 to Figure 4 presents the comparative results of slump tests and compaction factor tests. The slump and compaction factor values of control mix was 86 mm & 0.93.It was found that increasing the percentage of spent wash tends to increase the concrete slump and compaction factor. This is because Adsorption of hydrophilic surfactants on the surface of solid cement particles changes their electro kinetic potentials, decreases van der Waals forces in the system of cement-aggregate-water, and decreases the rate of coagulation of new structures formed during interaction of cement with water. In addition, hydrophilic surfactants ensure the best contact between reacting molecules of CaO, SiO2 and water. This result in the desired effect: a decrease in the internal friction and an increase in the fluidity of the concrete mixture. It was found that, when spent wash is added at 1.25% by weight of the cement the slump get collapsed.

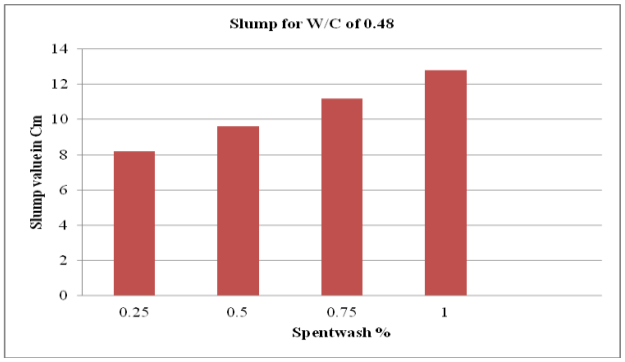

Figure 1: Slump Values of Spent Wash Concrete (W/C 0.48)

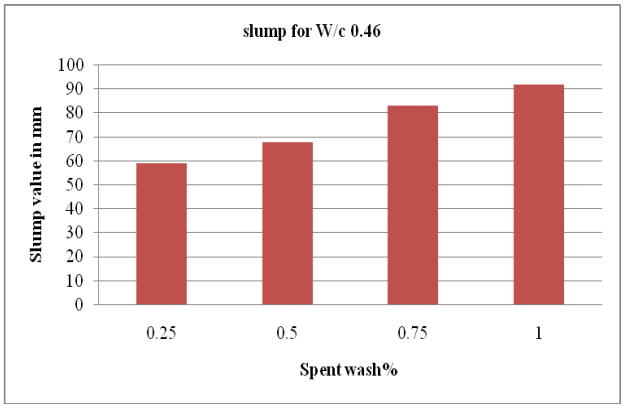

Figure 2: Slump Values of Spent Wash Concrete (W/C 0.46)

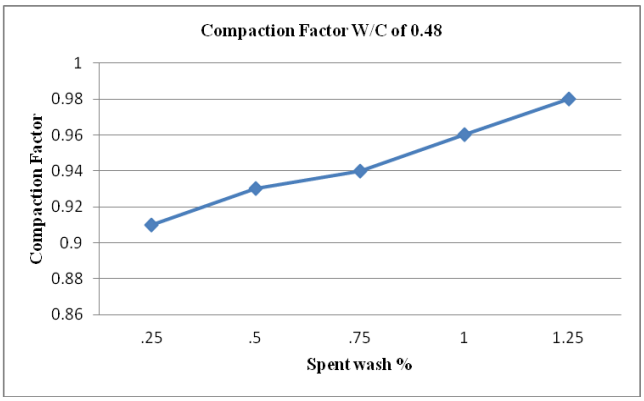

Figure 3: Compaction Factor for Spent Wash Concrete (W/C 0.48)

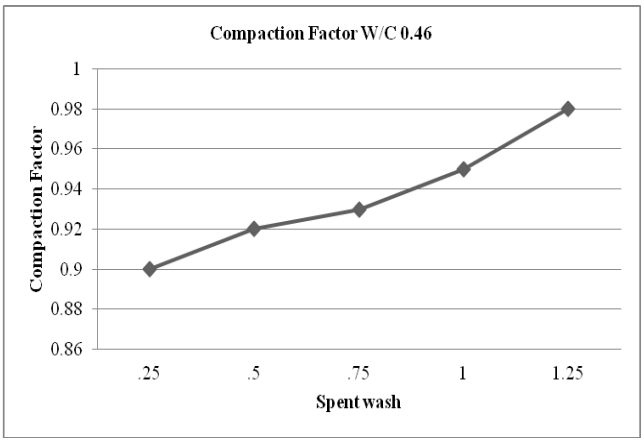

Figure 4: Compaction Factor for Spent Wash Concrete (W/C 0.46)

Compressive Strength

Figure 5 to Figure 8 shows test results of 7 day and 28 day Compressive strength of control concrete (PPC) and spent wash added concrete. The 7 day and 28 day Compressive strength of control concrete was 22.8 & 33.02 Mpa. It was found that adding spent wash up to 0.75% tends to increase the Compressive strength of concrete about 5-8%. Addition of spent wash increases the strength of concrete by improving its structure and increasing its homogeneity. This is because of the quantity of macromolecular micelle-forming compounds in the spent wash is an important factor creating favorable conditions for homogeneity in density of the concrete. Further increases in the dosage, cause aggregation of surfactant molecules; an avalanche increase in the amount of gels produced by hydration; and the formation of defects in the microstructure of concrete, resulting in a decrease in its strength.

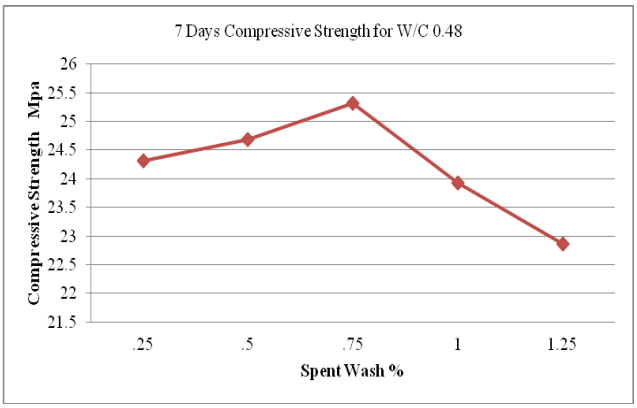

Figure 5: Compressive Strength of Spent Wash Concrete at 7 Days (W/C 0.48)

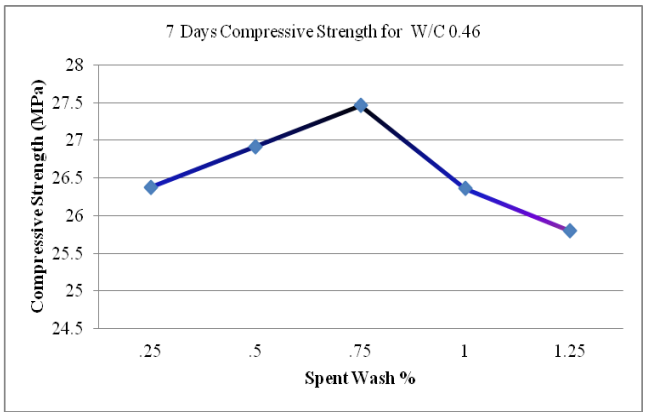

Figure 6: Compressive Strength of Spent Wash Concrete at 7 Days (W/C 0.46)

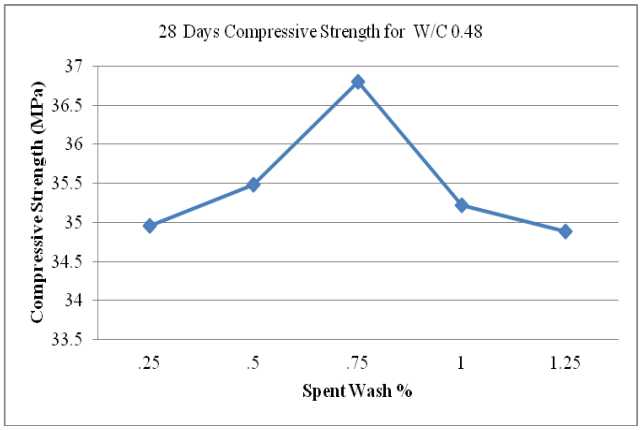

Figure 7: Compressive Strength of Spent Wash Concrete at 28 Days (W/C 0.48)

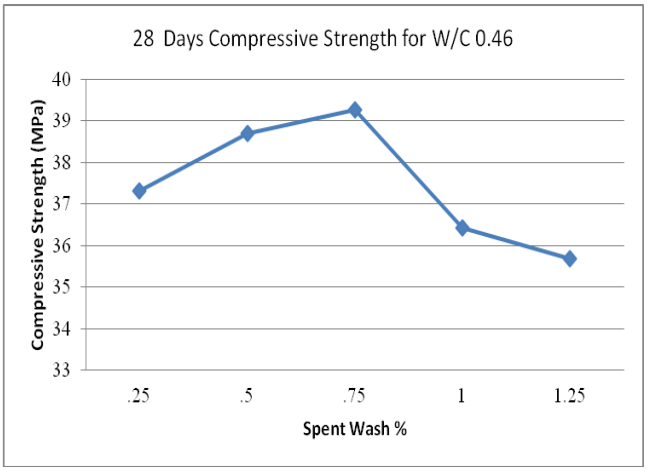

Figure 8: Compressive Strength of Spent Wash Concrete at 28 Days (W/C 0.46)

Flexural Strength

Figure 9 & Figure 10 shows test results of 28 day flexural strength of control concrete (PPC) and spent wash added concrete. It was found that adding spent wash up to 0.75% tends to increase the flexural strength of concrete about 1-2%. This is due to addition of spent wash improves the structure of concrete and its homogeneity.

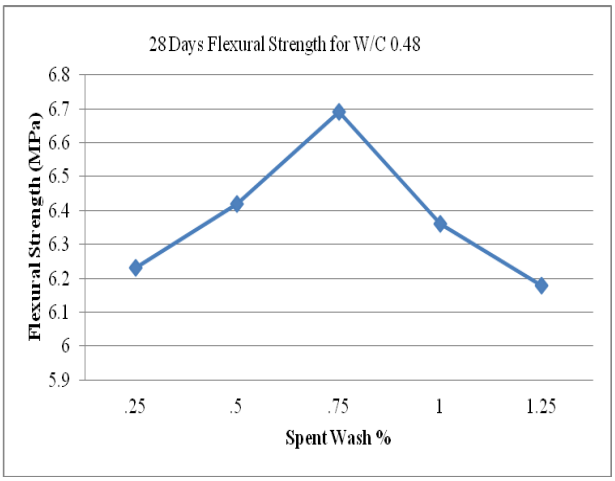

Figure 9: Flexural Strength of Spen Twash Concrete at 28 Days (W/C 0.48)

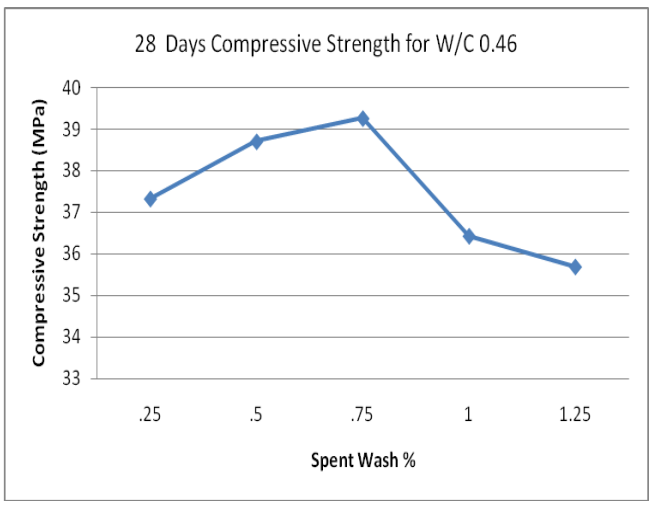

Figure 10: Compressive Strength of Spent Wash Concrete at 28 Days (W/C 0.46)

CONCLUSIONS

From the test results it has been found that by reducing the water content from the reference mix and by adding distillery spent wash.

- The workability has been considerably increased there by making the mix to be used in narrow sections, congested reinforcements etc.
- Up to 0.75% of spent wash addition the strength of concrete increased without addition of excess cement.
- It is possible to reduce the water content without sacrificing the workability and thus making the mix dense.

After elimination of excess reducing sugars and colored colloids from distillery spent wash, the properties of spent wash become similar to the properties of known super plasticizers, such as lignosulfonates or sulfated melamine formaldehyde and naphthalene-formaldehyde resins. Thus, waste material of distillery units are good modifiers of the properties of concrete. Wide use of distillery spent wash in the construction industry saves cement; improves the quality of concrete mixtures; and solves ecological problems, because the wastes from distillery units is dumped to water bodies and fields, which causes pollution of the environment and acidifies the arable soils.

REFERENCES

1. Batrakov, V.G., Modifitsirovannye betony. Teoriya i praktika (Modified Concretes: Theory and Practice), Moscow: Astra Sem, 1998.
2. Isheva, N.I., Concrete with Agents Obtained from Spent Native Solutions of Antibiotics Production, Cand. Sci (Techn.) Dissertation, Moscow, 1987.
3. Committee report ACI 212.4 R "Guide for the use of high range water –Reducing Admixtures (Super plasticizer)" In Concrete International 1993, pp 38-47.
4. Ramezanianpour A.A. "Super plasticizer: Their effect of the strength properties of concrete". Concrete international, 2002, pp 30-35.
5. Derle Thorpe.J and William A.corden "potential of water –Reducing Admixtures" Concrete International pp 36-38.
6. Manjrekar.S.K.., "Use of super plasticizer: Myths and Reality" ICJ June 1994, pp 317-320.
7. Vaidyanathan , R.Perumal and Antony Rajapazham "Experimental study on Evaluation of Concrete Admixtures" National conference on Admixtures IIT madras ,December 1992.
8. Banfill, P. F. G. ,The rheology of fresh cement and concrete - a review. 11 th International Congress on the Chemistry of Cement. Durban, South Africa.2003.
9. Bentz, D., A review of early-age properties of cement-based materials. 12 th International Congress on the Chemistry of Cement. Montreal, Canada, (2007).
10. Babushkin, V.I. and Kondrashchenko, V.I., New Building Materials Technology. Proc. Of MIIT, Moscow: Mosk. Inst. Inzh. Transp., 1997,Issue 9, pp. 65-70.
11. Min hong zhang and kare rekns.2010, "Effect of Modified Lignosulphonate Superplasticizer on Workability Retention and Initial Setting of Cement Pastes". Proc. Int. Conf. Singapore. pp 430-440.

12. Yoshioka, K., E. Tazawa, K. Kawai and T. Enohata (2002). "Adsorption characteristics of water-reducers on cement component minerals." Cement and Concrete Research, Vol:32, Issue 10:pp.1507-1513.

13. Bjornstrom, J. and S. Chandra. "Effect of superplasticizers on the rheological properties of Cements." Materials and Structures, 2003, Vol:32, Issue 10: pp 685-692.